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GEORGE C. MARSHALL SPACE FLIGHT CENTER

FINAL REPORT

PCM-FM; PAM-FM/FM

SIMULATOR

April 16, 1966

Contract NAS8-11589

Computer Control Company, Inc.
Old Connecticut Path
Framingham, Massachusetts

INTRODUCTION

This final report covers the design, fabrication, and installation of two (2) PCM-FM, PAM/FM/FM Simulator Systems under Contract NAS 8-11589. The systems were designed to meet the requirements of MSFC Quality and Reliability Assurance Laboratory Specification No. 104.

HISTORY OF THE CONTRACT

The contract to design and fabricate the first simulator system was awarded to Computer Control Company on June 30, 1964. Work on the contract commenced immediately with delivery scheduled for 30 September 1964. Changes to the contract involving additions to the system extended the design and fabrication phase of the program. Subsequently, shipment of the first simulator was made on 30 October 1964.

The first system was delivered to the Quality and Reliability Assurance Laboratory of the Marshall Space Flight Center and installed there by Computer Control Company personnel. In the course of a series of trips to MSFC during November and December of 1964, the simulator was installed, demonstrated to MSFC engineering personnel, and accepted by them for NASA. Electromagnetic compatibility (RFI) tests were also made at this time in a test chamber at the Quality and Reliability Assurance Laboratory, and a training course in the operation and maintenance of the simulator was conducted for MSFC engineering personnel.

A modification to the contract resulted in fabrication of a second simulator system. This system was shipped to MSFC on 10 May 1965. Installation and demonstration of the system was conducted at the Quality and Reliability Assurance Laboratory, MSFC.

DESCRIPTION OF SYSTEMS DELIVERED

Both simulator systems delivered to MSFC were virtually identical. Except for minor modifications made in the calibration simulation logic of the second system, the overall operational and physical characteristics remained the same.

Photographs of the simulator are shown in Figures 1 and 2. The simulator is housed in a cabinet approximately 40 inches high, 23 inches wide, and 24 inches deep. Components of the system were built as subassemblies and mounted in the cabinet for integration and final checkout. Figures 1 and 2 show that the subassembly located at the bottom of the cabinet is a high-speed magnetic core memory. Directly above the memory is a split-drawer assembly which contains all the logic modules to generate the output simulator patterns. Above the logic module drawer is a system control panel used to operate the simulator. The power supply for the system is located at the top of the cabinet.

The simulator system provides data trains which simulate pulse-coded (PCM) and pulse-amplitude (PAM) modulation. The input to the simulator is provided by a five-channel tape reader in the form of a series of numbers, in BCD form, ranging from 000 to 500. The simulator decodes these inputs, scales them between 000 and 999 and provides PCM and PAM outputs. The PCM output consists of 10-bit binary words, 2 words per channel, 30 channels per frame, 30 frames per master frame. Proper sync patterns are included in the PCM output. The PAM output consists of a series of analog voltage levels, with sync patterns at the end of each frame.

Special controls are included to vary the PAM pedestal and full scale levels. Also, a calibration mode is available to allow special calibration patterns to replace the standard data patterns of the PAM and PCM trains. A digital noise generator is designed into the simulator logic to permit simulation of varying degrees of random noise levels on the output data trains.

A block diagram of the simulator is shown in Figure 3. Although the block diagram is self-explanatory in many respects, a detailed description of each area may be found in the Operations and Maintenance Manual for the Simulator System, Computer Control Company Document No. 71-274. Three copies of this manual were delivered to MSFC with each Simulator System.

SUMMARY OF RESULTS

The purpose of the program was to produce an inexpensive, self-contained, stored program, test pattern generator to enable automatic and speedy calibration of vehicle telemetry systems and associated ground equipment. These results were achieved. The systems were designed and built by using straightforward, well known, logic techniques and by employing standard off-the-shelf digital logic modules as building blocks to assemble the various functional subsystems. Since it was not necessary to develop any new design approaches or any new logic circuitry, Computer Control Company was able to deliver, in minimum time, systems which are high in reliability and low in complexity.

The systems as delivered enabled MSFC engineering personnel to perform vehicle checkout in a shorter time, and replaced more expensive and cumbersome calibration techniques.

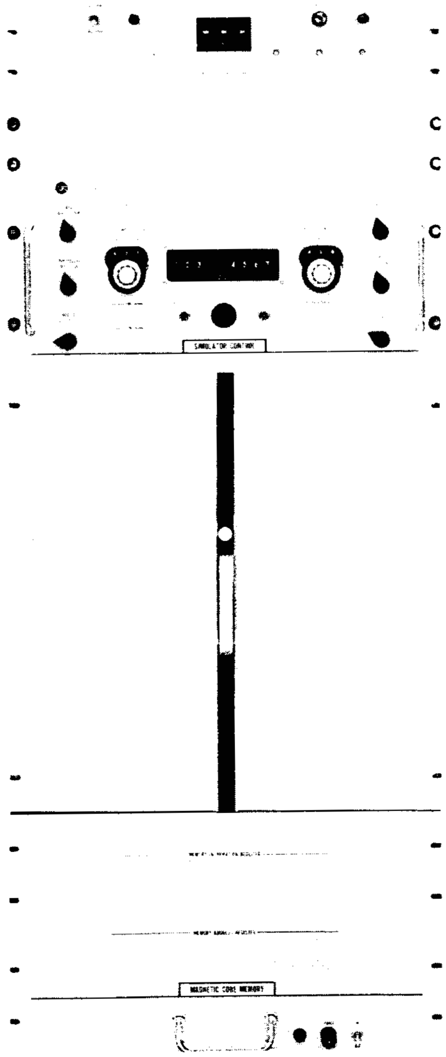

Figure 1. PCM-FM; PAM-FM/FM Simulator

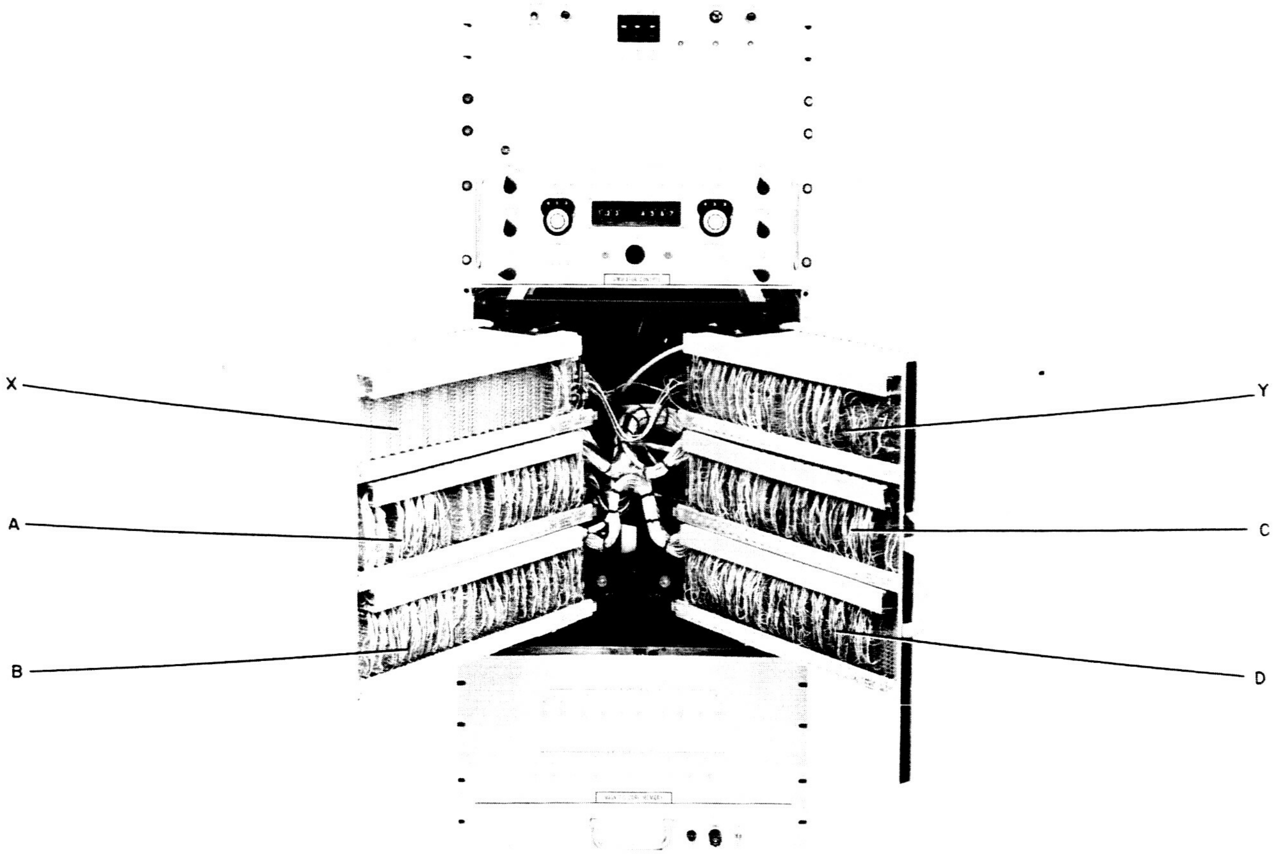

Figure 2. Simulator, Logic BLOCs

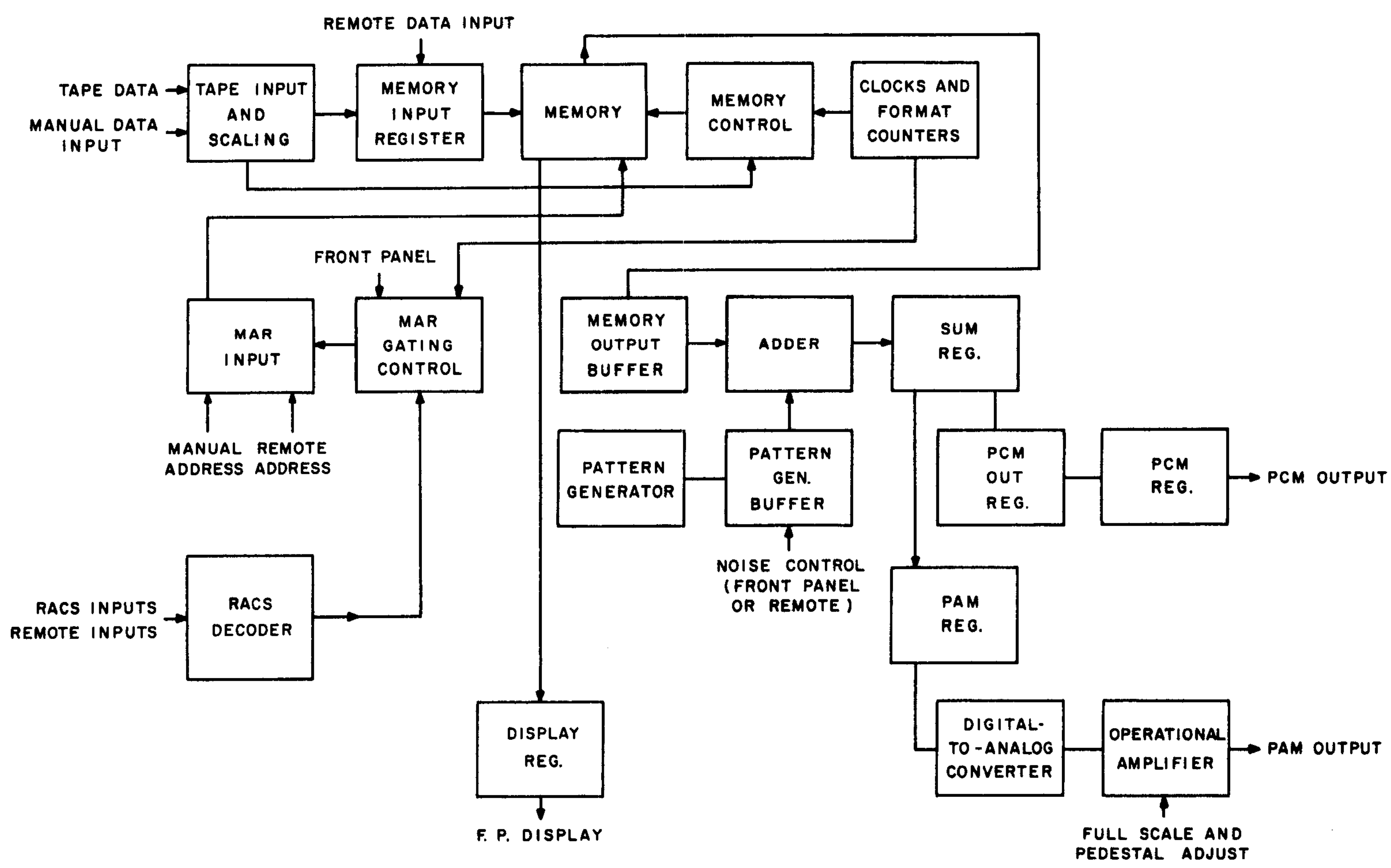

Figure 3. Simulator, Block Diagram